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**INTERNAL BALLISTICS MODEL UPDATE
FOR ASRM DOME
(5-32498)**

Final Technical Report for the Period
August 31, 1990 through February 20, 1991

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PREFACE

This technical report was prepared by the staff of the Research Institute, The University of Alabama in Huntsville. It documents the research performed under contract NAS8-36955, Delivery Order 101. Dr. Billy Jenkins was the Principal Investigator. Technical work was accomplished by Dr. Billy Jenkins, Mr. Mark Bowden, and Dr. Larry Dunbar. Mr. Douglas Blackwell, Propulsion Laboratory, provided technical coordination.

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official National Aeronautics and Space Administration, Marshall Space Flight Center position, policy, or decision unless so designated by other official documentation.

I have reviewed this report, dated Feb. 1991 and the report contains no classified information.


Principal Investigator

Approval:

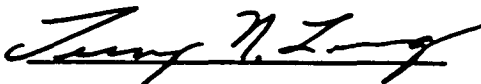

Research Institute

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1 INTRODUCTION

The HEAD program models the head dome complex burning region of NASA's Advanced Solid Rocket Motor (ASRM) design. In keeping with the generality of the CBRM-A program, HEAD has been written as general as possible in the allotted time. Also, the software was developed so as to allow a smooth integration into the CBRM-A program. This approach allows the head dome to be studied separately or as a part of the whole motor.

2 STAND-ALONE PROGRAM HEAD

2.1 Methodology

The method used for modeling the head dome is similar to that used for the transition region of CBRM-A. The desired quantities are the same: the grain surface area, the port volume, and the surface area of the exposed case. Numerical integration is used to determine the grain surface area and the change in port volume. The initial port volume is calculated to which is added the change in port volume at each burn distance step to give the current port volume.

Notable points of intersection of the various surfaces comprising the head dome are calculated (Fig. 1) and the head dome is divided into many small volumes bounded by cross-sectional planes with normals parallel to the z-axis (Fig. 2). Within each plane of cross-section the length of the curve associated with each head dome surface is calculated and these lengths are summed for a total burning-surface curve length within the cross-section. These curve lengths are numerically integrated using the trapezoidal rule yielding the grain surface area (the exposed-case surface area is treated similarly). The resulting grain surface areas are also integrated by the trapezoidal rule yielding the change in port volume which is added to the initial port volume at each step.

There is one surface not included in the cross-sections (labelled SURFHD in Fig. 1) since the surface normal is parallel to the z-axis. The calculation of the contributions to the burning surface area or exposed-case surface area of this component is simple and is done directly.

Generalization in the head dome is much more difficult than in the star and cylindrical regions. Simply moving a surface often necessitates creating new surfaces to fill gaps (Fig. 3b). This is the case with the ASRM design used during the development of the program. The errors introduced by the lack of these gap-filling surfaces is usually quite small as can be seen in Fig. 4.

2.2 Input

Input to the HEAD program is a NAMELIST file identical to that of the CBRM-A and the combined CBRM-A/HEAD programs. This allows the creation of one NAMELIST file to be used with any of the programs avoiding the need for multiple input files for a given grain design. HEAD required the addition of several variables to the NAMELIST file to describe the geometry of the head dome. These variables are shown in Fig. 5. Note that *conx1* and *conx2* describe characteristics of the star region. This is necessary to match the slope of the star valley floor with the head valley floor.

2.3 Output

Program HEAD produces a tabulation of the burn distance, the grain surface area, the exposed case surface area, and the port volume (see appendix A). The code was developed on a Silicon Graphics IRIS 4D graphics workstation. Graphical debugging aids were incorporated into the code to provide three-dimensional views of the head dome surface as it burns back. A two-dimensional cross-section is also displayed at any specified z-position. This visualization allows an analyst to recognize inconsistencies in input geometry much more quickly.

3 CBRM WITH HEAD

3.1 Description

Program HEAD has been combined with the CBRM program developed by UAH resulting in a simulation of the complex burning region of the entire motor. Two subroutines were added, *hedset* and *hedbrn*, which calculate surface parameters and regress the grain for a given burn distance, respectively. The methodology employed is the same as that for the stand-alone program HEAD. Input to the CBRM-A/HEAD program is a NAMELIST identical to the CBRM-A program with the added variables as shown in Fig. 5.

3.2 Output

Subroutine *hedbrn* interfaces with the program just as the subroutines for the other regions of the motor do. Currently, the *iosubs* routines have been modified along with the output section of the main program in order to provide tabulated output of the grain surface area similar to the output of the other routines. A sample of the output is provided in appendix C.

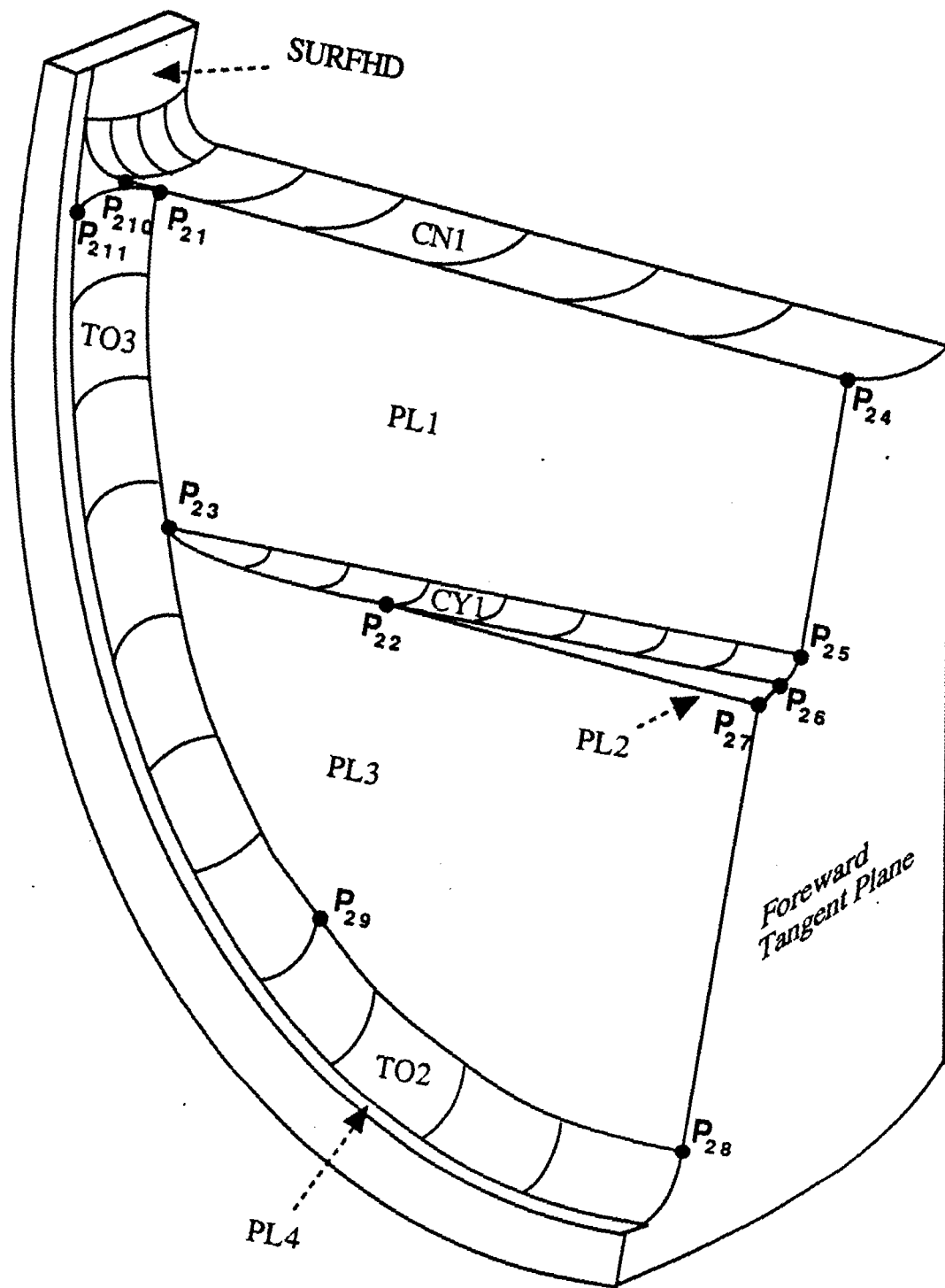
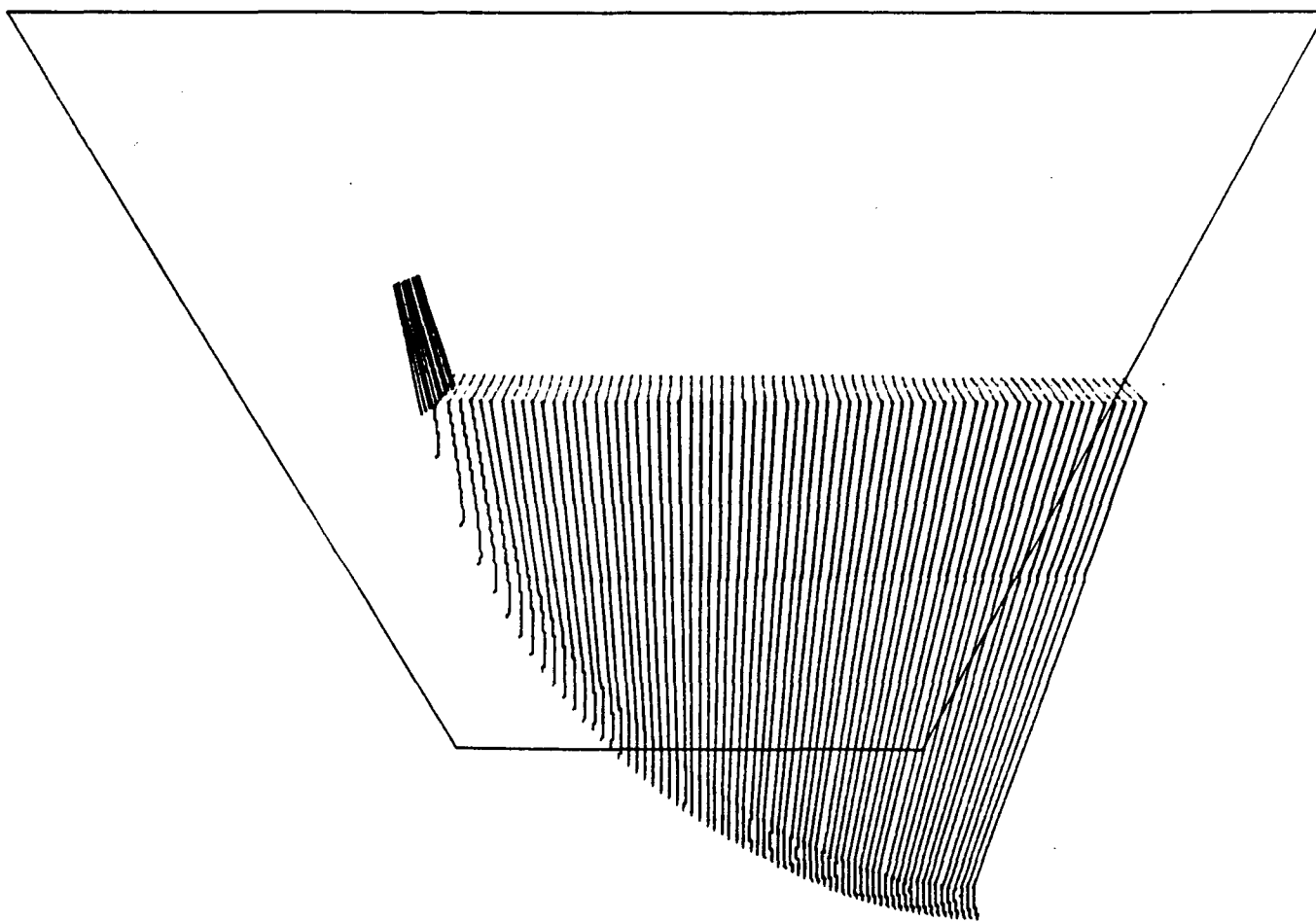
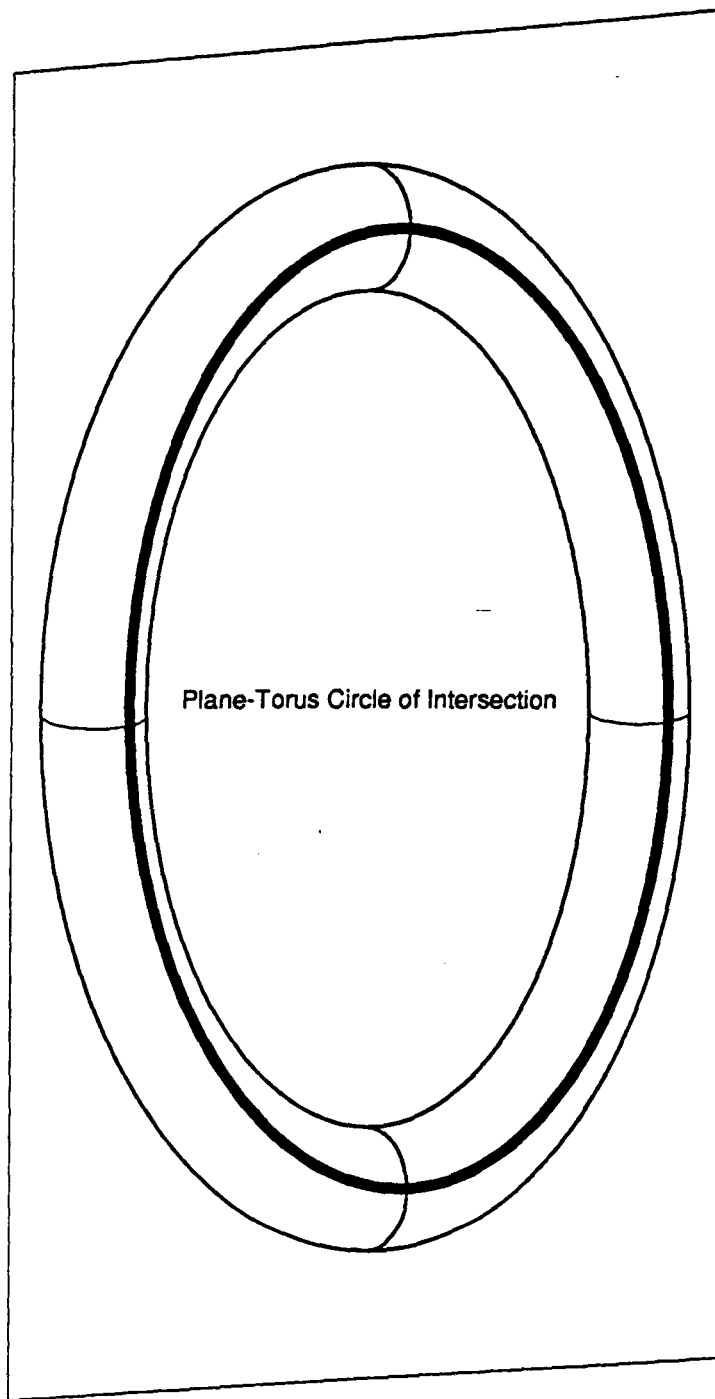


Fig. 1

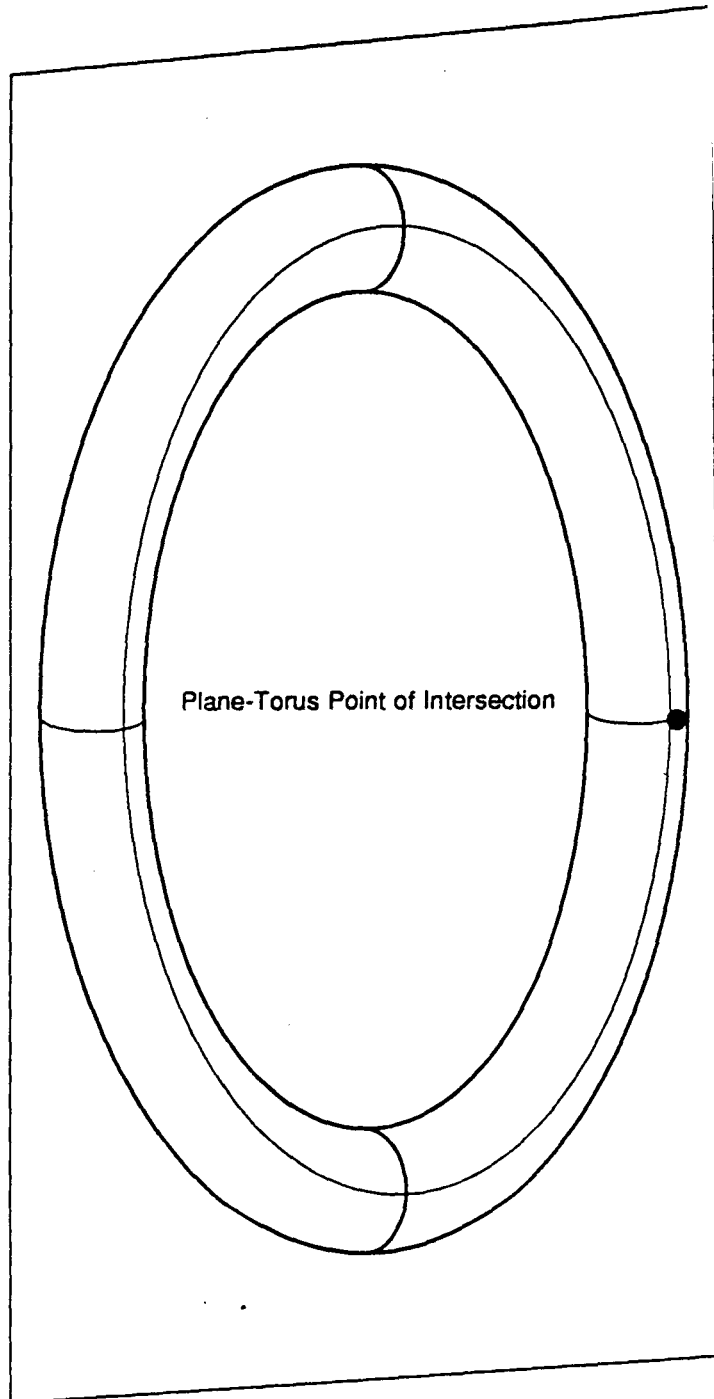


Three-dimensional view of the head region.

Fig. 2



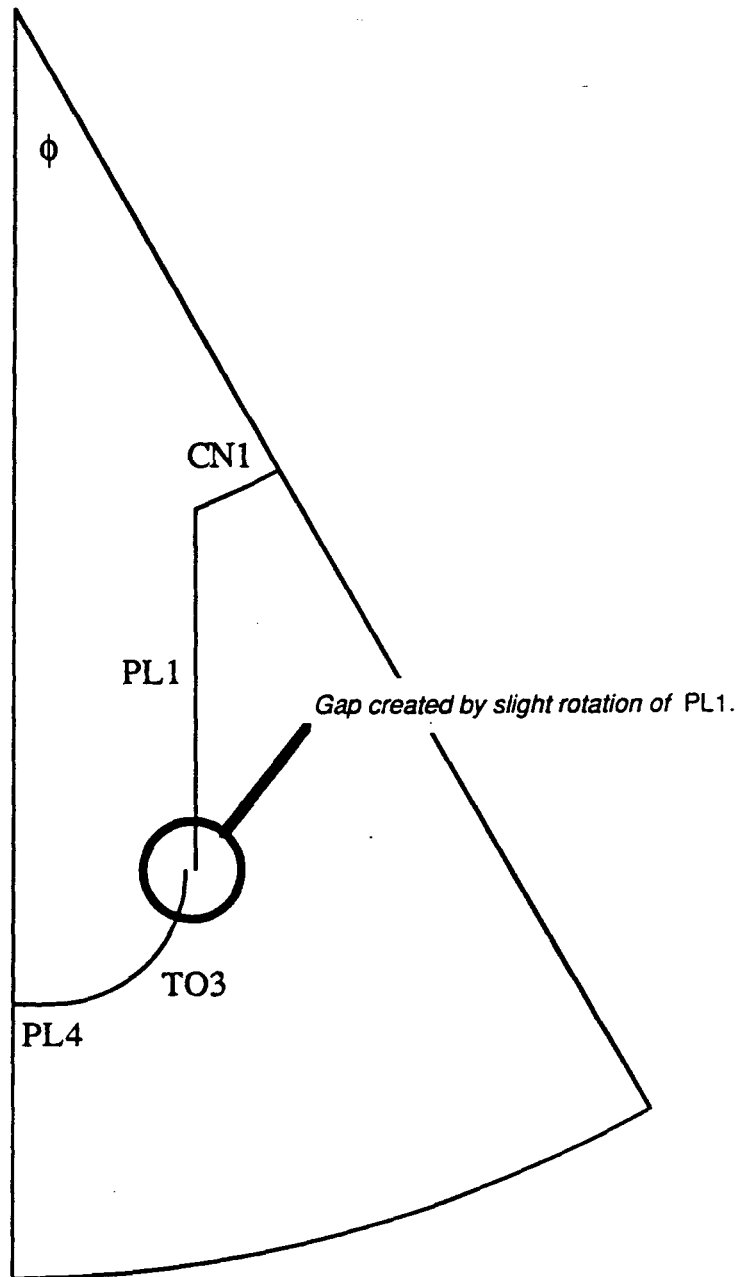
a.



b.

Rotating the plane slightly creates a small gap between the plane and the torus.

Fig. 3



Cross-section through motor in the head region showing only half of a peak and valley.

Fig. 4

APPENDIX A

NAMelist Input

** BEGIN PROGRAM CBRM **

CBRM INPUT DATA FOLLOWS...

\$IB2DAT

```
AINCIN = 44.07500000000000 , 83.94500000000000 ,
186.35500000000000 , 205.88500000000000 , 294.07500000000000 ,
361.39700000000000 , 362.24500000000000 , 367.38900000000000 ,
368.23700000000000 , 394.07500000000000 , 444.07500000000000 ,
478.96500000000000 , 525.19700000000000 , 527.42000000000000 ,
566.69000000000000 , 681.39700000000000 , 682.24700000000000 ,
687.38700000000000 , 688.23700000000000 , 694.07500000000000 ,
769.07500000000000 , 832.79700000000000 , 841.39700000000000 ,
842.24700000000000 , 847.38700000000000 , 848.23700000000000 ,
877.29500000000000 , 959.84600000000000 , 1005.35700000000000 ,
1007.59700000000000 , 1101.86700000000000 , 1194.07500000000000 ,
1297.28200000000000 , 1327.58200000000000 , 1333.70200000000000 ,
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29.41000000000000 , 29.41700000000000 , 29.63600000000000 ,
30.06100000000000 , 30.36000000000000 , 30.75000000000000 ,
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29.19610000000000 , 29.20170000000000 , 29.24000000000000 ,
29.73660000000000 , 30.15820000000000 , 30.21510000000000 ,
30.22080000000000 , 30.25480000000000 , 30.26040000000000 ,
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42.60000000000000 , 45.62700000000000 , 15*0.0000000000000000E+00,
RVF = 63.45000000000000 , 64.80000000000000 ,
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30.36000000000000 , 55.00000000000000 , 2*28.40000000000000 ,
29.15650000000000 , 29.16210000000000 , 29.19610000000000 ,
29.20170000000000 , 29.24000000000000 , 29.73660000000000 ,
30.15820000000000 , 30.21510000000000 , 30.22080000000000 ,
30.25480000000000 , 30.26040000000000 , 30.45270000000000 ,
30.99890000000000 , 55.00000000000000 , 2*30.70000000000000 ,
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2*74.31700000000000 , 4*74.37500000000000 , 68.00000000000000 ,
70.50000000000000 , 2*74.37500000000000 , 2*74.31700000000000 ,
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3*0.0000000000000000E+00,
TIF = 2*0.3000000000000000 , 3*0.0000000000000000E+00,
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TIA = 5*0.0000000000000000E+00,
```

```

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NRF       = 3,
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RTOPTF    = 2.073370000000000 ,
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YLOA      = 1.875000000000000 ,
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XHIF      = 28.647000000000000 ,
XLOF      = 29.000000000000000 ,
WIDCO     = 6.000000000000000 ,
RBOTTP    = 1.620000000000000 ,
R3        = 4.000000000000000 ,
FR        = 1.620000000000000 ,
DELZ      = 20.000000000000000 ,
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IDPNOZ    = 2,
NOIDPS    = 5,
NOCASE    = 17,
NOCASA    = 4,
TMAX      = 100.0000000000000 ,
DTAU      = 0.500000000000000 ,
NDUMP     = 100,
NDUMPE    = 0,
RANGLO    = 0.000000000000000E+00,
RANGHI    = 0.000000000000000E+00,
TSTART    = 0.000000000000000E+00,
RTO       = 0.000000000000000E+00,
ZTO       = 201.3850000000000 ,
CONX1     = 63.450000000000000 ,
CONX2     = 64.800000000000000 ,
CONX3     = 17.000000000000000 ,
CONZ3     = 11.500000000000000 ,
CONZ4     = 3.000000000000000 ,
HDBFX     = 15.280000000000000 ,
HDBFZ     = 66.454000000000000 ,

```

HDBFR = 55.00000000000000
HDSFR = 20.00000000000000
\$END

APPENDIX B

Program HEAD Output

BURN DIST

0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000
6.500
7.000
7.500
8.000
8.500
9.000
9.500
10.000
10.500
11.000
11.500
12.000
12.500
13.000
13.500
14.000
14.500
15.000
15.500
16.000
16.500
17.000
17.500
18.000
18.500
19.000
19.500
20.000
20.500
21.000

GRAIN SURFACE

28692.507
28797.976
28924.962
29071.487
29229.266
29396.840
29577.939
29772.194
29875.438
29443.561
29017.832
28589.040
28158.861
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27388.082
24287.677
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20582.933
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14801.753
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12214.030
10979.363
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6434.027
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4421.665
3512.572
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2162.800
1598.228
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636.045
273.956
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0.000
0.000
0.000
0.000

EXPOSED CASE SURF

0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
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14294.379
14548.371
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14955.374
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15164.956
15164.956

PORT VOLUME

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407442.389
409425.948
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414563.090
414563.090
414563.090

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APPENDIX C

CBRM/HEAD Output

** BEGIN PROGRAM CBRM **
 CBRM INPUT DATA FOLLOWS...

\$IB2DAT

```

AINCIN = 44.07500000000000 , 83.9450000000000000
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877.29500000000000 , 959.84600000000000 , 1005.35700000000000 ,
1007.59700000000000 , 1101.86700000000000 , 1194.07500000000000 ,
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RI = 3*17.00000000000000 , 28.0000000000000000
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29.73660000000000 , 30.15820000000000 , 30.21510000000000 ,
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RVF = 63.45000000000000 , 64.80000000000000
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30.13820000000000 , 30.21510000000000 , 30.22080000000000 ,
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4*74.37500000000000 , 74.37100000000000 , 74.31300000000000 ,
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74.31700000000000 , 68.00000000000000 , 70.12000000000000 ,

```

C-2

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FR      = 1.6200000000000000
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NOIDPS  = 5,
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NOCASA  = 4,
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DTAU    = 0.5000000000000000
NDUMP   = 100,
NDUMPE  = 0,
RANGLO  = 0.0000000000000000E+00,
RANGHI  = 0.0000000000000000E+00,
TSTART  = 0.0000000000000000E+00,
RTO     = 0.0000000000000000E+00,
ZTO     = 201.38500000000000
CONX1   = 63.45000000000000
CONX2   = 64.80000000000000
CONX3   = 17.00000000000000
CONZ3   = 11.50000000000000
CONZ4   = 3.00000000000000
HDBFX   = 15.28000000000000
HDBFZ   = 66.45400000000000
HDBFR   = 55.00000000000000
HDSFR   = 20.00000000000000
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END OF INEUT DATA

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83.945000	17.000000	63.180000	73.103000	0.00000000E+00
103.94500	17.000000	63.287411	73.210411	0.00000000E+00
123.94500	17.000000	63.394823	73.317823	0.00000000E+00
143.94500	17.000000	63.502234	73.425234	0.00000000E+00
163.94500	17.000000	63.609646	73.532646	0.00000000E+00
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205.88500	28.000000	62.510000	74.253000	0.00000000E+00
225.88500	28.178478	28.178478	74.270009	0.00000000E+00
245.88500	28.356957	28.356957	74.287017	0.00000000E+00
265.88500	28.535435	28.535435	74.304026	0.00000000E+00
285.88500	28.713913	28.713913	74.321035	0.00000000E+00
294.07500	28.787000	28.787000	74.328000	0.00000000E+00
314.07500	28.956930	28.956930	74.328000	0.00000000E+00
334.07500	29.126859	29.126859	74.328000	0.00000000E+00
354.07500	29.296789	29.296789	74.328000	0.00000000E+00
361.39700	29.359000	29.359000	74.328000	0.00000000E+00
362.24500	29.366000	29.366000	74.270000	0.00000000E+00
367.38900	29.410000	29.410000	74.270000	0.00000000E+00
368.23700	29.417000	29.417000	74.328000	0.00000000E+00
388.23700	29.586518	29.586518	74.328000	0.00000000E+00

391.07500	29.636000	29.636000	74.328000	0.000000000E+00
414.07500	29.806000	29.806000	74.328000	0.000000000E+00
434.07500	29.976000	29.976000	74.328000	0.000000000E+00
444.07500	30.061000	30.061000	74.328000	0.000000000E+00
464.07500	30.232396	30.232396	74.328000	0.000000000E+00
478.96500	30.360000	30.360000	74.328000	0.000000000E+00
486.01786	30.419496	30.419496	73.984406	0.000000000E+00***
525.19700	30.750000	55.000000	67.953000	0.000000000E+00
527.42000	28.400000	28.400000	70.453000	0.000000000E+00
533.01500	28.400000	28.400000	74.328000	0.000000000E+00
553.97500	28.400000	28.400000	74.328000	0.000000000E+00
566.69000	28.400000	28.400000	74.328000	0.000000000E+00
585.69000	28.531901	28.531901	74.328000	0.000000000E+00
605.69000	28.663803	28.663803	74.328000	0.000000000E+00
625.69000	28.795704	28.795704	74.328000	0.000000000E+00
645.69000	28.927605	28.927605	74.328000	0.000000000E+00
665.69000	29.059506	29.059506	74.328000	0.000000000E+00
681.39700	29.156500	29.156500	74.328000	0.000000000E+00
682.24700	29.162100	29.162100	74.270000	0.000000000E+00
687.38700	29.196100	29.196100	74.270000	0.000000000E+00
686.23700	29.201700	29.201700	74.328000	0.000000000E+00
694.07500	29.240000	29.240000	74.328000	0.000000000E+00
714.07500	29.372427	29.372427	74.328000	0.000000000E+00

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1074.6160	30.700000	30.700000	74.073000	0.00000000E+00
1094.6160	30.700000	30.700000	74.073000	0.00000000E+00
1101.8670	30.700000	30.700000	74.073000	0.00000000E+00
1121.8670	31.754420	31.754420	73.987975	0.00000000E+00
1141.8670	32.808841	32.808841	73.902950	0.00000000E+00
1161.8670	33.863261	33.863261	73.817925	0.00000000E+00
1181.8670	34.917682	34.917682	73.732899	0.00000000E+00
1194.0750	35.561300	35.561300	73.681000	0.00000000E+00
1214.0750	36.615725	36.615725	73.597091	0.00000000E+00
1234.0750	37.670149	37.670149	73.513182	0.00000000E+00
1254.0750	38.724574	38.724574	73.429273	0.00000000E+00
1274.0750	39.778998	39.778998	73.345364	0.00000000E+00
1294.0750	40.833423	40.833423	73.261455	0.00000000E+00
1297.2820	41.002500	41.002500	73.248000	0.00000000E+00
1317.2820	42.056955	42.056955	72.838099	0.00000000E+00
1327.5820	42.600000	42.600000	72.627000	0.00000000E+00
1353.7020	45.627000	45.627000	72.144000	0.00000000E+00
31	65	0	0	0
31	66	0	0	0

2.10057	-0.10368	1.99688
0.63180	0.00000	0.63180
MAR= 0	CASVOL= 0.00000000D+00	VOLINE= 0.00000000D+00
MAR= 1	CASVOL= 0.32691845D+06	VOLINE= 0.00000000D+00
MAR= 2	CASVOL= 0.65757365D+06	VOLINE= 0.00000000D+00
MAR= 3	CASVOL= 0.99384372D+06	VOLINE= 0.00000000D+00
MAR= 4	CASVOL= 0.13311020D+07	VOLINE= 0.00000000D+00
MAR= 5	CASVOL= 0.16693498D+07	VOLINE= 0.00000000D+00

MAR= 6 CASVOL= 0.20085888D+07 VOLINE= 0.00000000D+00
MAR= 7 CASVOL= 0.20495341D+07 VOLINE= 0.00000000D+00
MAR= 8 CASVOL= 0.23898852D+07 VOLINE= 0.00000000D+00
MAR= 9 CASVOL= 0.27254420D+07 VOLINE= 0.00000000D+00
MAR= 10 CASVOL= 0.30719453D+07 VOLINE= 0.00000000D+00
MAR= 11 CASVOL= 0.34186073D+07 VOLINE= 0.00000000D+00
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MAR= 24 CASVOL= 0.63371241D+07 VOLINE= 0.00000000D+00
MAR= 25 CASVOL= 0.66842482D+07 VOLINE= 0.00000000D+00
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MAR= 29 CASVOL= 0.75852141D+07 VOLINE= 0.00000000D+00
MAR= 32 CASVOL= 0.83631705D+07 VOLINE= 0.15009997D+04
MAR= 33 CASVOL= 0.87102946D+07 VOLINE= 0.15009997D+04
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CPBURN VALUES-----	PSIBAR=	6.2831852	PORT PERIMETER=	179.29342	PORT AREA=	2558.1079
CPBURN VALUES-----	PSIBAR=	6.2831852	PORT PERIMETER=	180.41483	PORT AREA=	2590.2079
CPBURN VALUES-----	PSIBAR=	6.2831852	PORT PERIMETER=	180.87405	PORT AREA=	2603.4107
CPBURN VALUES-----	PSIBAR=	6.2831852	PORT PERIMETER=	181.94175	PORT AREA=	2634.2372
CPBURN VALUES-----	PSIBAR=	6.2831852	PORT PERIMETER=	183.00945	PORT AREA=	2665.2452
CPBURN VALUES-----	PSIBAR=	6.2831852	PORT PERIMETER=	184.07715	PORT AREA=	2696.4347
CPBURN VALUES-----	PSIBAR=	6.2831852	PORT PERIMETER=	184.46803	PORT AREA=	2707.8985

CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	184.51202	PORT AREA=	2709.1899
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CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	184.83246	PORT AREA=	2718.6082
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CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	190.75750	PORT AREA=	2895.6989
CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	191.13133	PORT AREA=	2907.0593
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CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	178.44246	PORT AREA=	2533.8829
CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	178.44246	PORT AREA=	2533.8829
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CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	192.89379	PORT AREA=	2960.9196
CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	192.89379	PORT AREA=	2960.9196
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CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	264.25164	PORT AREA=	5556.8097
CPBURN VALUES----	PSIBAR=	6.2831852	PORT PERIMETER=	267.66369	PORT AREA=	5701.2366
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PARAMETER SUMMARY-GRAIN DESIGN (THIOKOL) TC227CDR

PRECEDING PAGE BLANK NOT FILMED

C-14

C-15

TOTAL BURN AREA---CYLINDRICAL+AFT SECTIONS---SQUARE INCHES			
.00000000E+00	421564.54	17.000000	388002.59
.50000000	425032.99	17.500000	384622.31
1.00000000	428844.19	18.000000	381792.09
1.50000000	432571.49	18.500000	379294.93
2.00000000	436243.08	19.000000	377149.14
2.50000000	439992.78	19.500000	375400.35
3.00000000	443175.23	20.000000	373893.76
3.50000000	445191.08	20.500000	374920.02
4.00000000	446060.06	21.000000	377354.86
4.50000000	446503.05	21.500000	380648.56
5.00000000	446878.27	22.000000	382780.99
5.50000000	447609.52	22.500000	384935.66
6.00000000	449018.87	23.000000	387092.82
6.50000000	451254.71	23.500000	389278.70
7.00000000	454265.39	24.000000	391416.17
7.50000000	455632.07	24.500000	393559.33
8.00000000	456168.69	25.000000	395816.52
8.50000000	449933.92	25.500000	398022.61
9.00000000	443936.03	26.000000	400193.57
9.50000000	439782.93	26.500000	402421.88
10.000000	436261.43	27.000000	404615.75
10.500000	433089.88	27.500000	406828.64
11.000000	430090.31	28.000000	408946.40
11.500000	427062.30	28.500000	411003.91
12.000000	424165.17	29.000000	413036.51
12.500000	421437.90	29.500000	415017.93
13.000000	418710.37	30.000000	416934.99
13.500000	415073.26	30.500000	418883.52
14.000000	411088.20	31.000000	420827.36
14.500000	407279.63	31.500000	418362.56
15.000000	403552.72	32.000000	415564.21
15.500000	399723.01	32.500000	412538.30
16.000000	395904.42	33.000000	409365.02
16.500000	391969.98	33.500000	406158.52
		34.000000	404310.60
		34.500000	402394.56
		35.000000	400508.62
		35.500000	398859.92
		36.000000	395823.21
		36.500000	393501.46
		37.000000	391067.75
		37.500000	389753.62
		38.000000	386541.10
		38.500000	384263.13
		39.000000	382062.85
		39.500000	379726.99
		40.000000	377061.81
		40.500000	374366.79
		41.000000	371616.64
		41.500000	368823.37
		42.000000	365986.89
		42.500000	362723.90
		43.000000	358600.18
		43.500000	298037.33
		44.000000	261373.46
		44.500000	200711.36
		45.000000	138527.72
		45.500000	75825.094
		46.000000	2947.4317
		46.500000	.00000000E+00
		47.000000	.00000000E+00
		47.500000	.00000000E+00
		48.000000	.00000000E+00
		48.500000	.00000000E+00
		49.000000	.00000000E+00
		49.500000	.00000000E+00
		50.000000	.00000000E+00
		.00000000E+00	.00000000E+00

FUEL SURFACE AREA---STAR REGION---SQUARE INCHES

.00000000E+00	160926.52	17.000000	24078.521	34.000000	.00000000E+00
.50000000	160701.05	17.500000	19133.796	34.500000	.00000000E+00
1.00000000	160516.48	18.000000	14876.919	35.000000	.00000000E+00
1.50000000	160355.75	18.500000	11024.766	35.500000	.00000000E+00
2.00000000	160216.78	19.000000	7437.6542	36.000000	.00000000E+00
2.50000000	160097.22	19.500000	4038.0884	36.500000	.00000000E+00
3.00000000	159401.12	20.000000	887.80222	37.000000	.00000000E+00
3.50000000	157578.67	20.500000	.00000000E+00	37.500000	.00000000E+00
4.00000000	154740.44	21.000000	.00000000E+00	38.000000	.00000000E+00
4.50000000	151708.26	21.500000	.00000000E+00	38.500000	.00000000E+00
5.00000000	148685.60	22.000000	.00000000E+00	39.000000	.00000000E+00
5.50000000	145937.68	22.500000	.00000000E+00	39.500000	.00000000E+00
6.00000000	143933.09	23.000000	.00000000E+00	40.000000	.00000000E+00
6.50000000	142827.18	23.500000	.00000000E+00	40.500000	.00000000E+00
7.00000000	142439.73	24.000000	.00000000E+00	41.000000	.00000000E+00
7.50000000	140432.97	24.500000	.00000000E+00	41.500000	.00000000E+00
8.00000000	137575.69	25.000000	.00000000E+00	42.000000	.00000000E+00
8.50000000	128232.30	25.500000	.00000000E+00	42.500000	.00000000E+00
9.00000000	119142.39	26.000000	.00000000E+00	43.000000	.00000000E+00
9.50000000	111843.61	26.500000	.00000000E+00	43.500000	.00000000E+00
10.000000	105164.44	27.000000	.00000000E+00	44.000000	.00000000E+00
10.500000	98812.331	27.500000	.00000000E+00	44.500000	.00000000E+00
11.000000	92663.102	28.000000	.00000000E+00	45.000000	.00000000E+00
11.500000	86651.577	28.500000	.00000000E+00	45.500000	.00000000E+00
12.000000	80739.153	29.000000	.00000000E+00	46.000000	.00000000E+00
12.500000	74901.084	29.500000	.00000000E+00	46.500000	.00000000E+00
13.000000	69120.581	30.000000	.00000000E+00	47.000000	.00000000E+00
13.500000	63385.770	30.500000	.00000000E+00	47.500000	.00000000E+00
14.000000	57687.966	31.000000	.00000000E+00	48.000000	.00000000E+00
14.500000	52020.650	31.500000	.00000000E+00	48.500000	.00000000E+00
15.000000	46378.821	32.000000	.00000000E+00	49.000000	.00000000E+00
15.500000	40758.571	32.500000	.00000000E+00	49.500000	.00000000E+00
16.000000	35156.800	33.000000	.00000000E+00	50.000000	.00000000E+00
16.500000	29571.015	33.500000	.00000000E+00	.00000000E+00	.00000000E+00

FUEL SURFACE AREA---TRANSITION REGION---SQUARE INCHES

.00000000E+00	13321.003	17.000000	9461.8101	34.000000	2350.6101
.50000000	13598.172	17.500000	9095.8159	34.500000	2305.6839
1.00000000	13854.465	18.000000	8599.6756	35.000000	2326.8197
1.50000000	14116.550	18.500000	8042.2928	35.500000	2621.2595
2.00000000	14317.205	19.000000	7567.2954	36.000000	1563.9055
2.50000000	14581.605	19.500000	7200.0628	36.500000	1257.8392
3.00000000	14858.916	20.000000	6839.4680	37.000000	876.22491
3.50000000	15102.437	20.500000	6372.6317	37.500000	1650.7236
4.00000000	15304.073	21.000000	6408.3616	38.000000	563.43349
4.50000000	15292.298	21.500000	6021.9500	38.500000	444.79328
5.00000000	15211.310	22.000000	5748.2395	39.000000	439.24142
5.50000000	15219.744	22.500000	5499.1681	39.500000	433.26042
6.00000000	15171.084	23.000000	5255.9310	40.000000	427.00704
6.50000000	15056.605	23.500000	5052.1921	40.500000	433.39091
7.00000000	15001.104	24.000000	4835.6068	41.000000	427.17135
7.50000000	14929.022	24.500000	4649.0800	41.500000	420.42135
8.00000000	14885.502	25.000000	4495.8516	42.000000	413.09833
8.50000000	14564.833	25.500000	4336.1408	42.500000	358.78272
9.00000000	14235.715	26.000000	4151.3578	43.000000	349.11290
9.50000000	13968.429	26.500000	4031.3565	43.500000	338.66264
10.00000000	13721.304	27.000000	3883.9718	44.000000	346.13564
10.50000000	13542.866	27.500000	3760.2977	44.500000	335.14392
11.00000000	13344.693	28.000000	3630.8230	45.000000	323.26663
11.50000000	12998.073	28.500000	3516.6843	45.500000	310.49133
12.00000000	12710.957	29.000000	3387.1267	46.000000	168.79064
12.50000000	12528.571	29.500000	3249.5075	46.500000	.00000000E+00
13.00000000	12297.584	30.000000	3100.9625	47.000000	.00000000E+00
13.50000000	11896.533	30.500000	3000.3603	47.500000	.00000000E+00
14.00000000	11616.962	31.000000	2902.5066	48.000000	.00000000E+00
14.50000000	11299.736	31.500000	2788.5807	48.500000	.00000000E+00
15.00000000	11010.797	32.000000	2684.4941	49.000000	.00000000E+00
15.50000000	10643.911	32.500000	2536.1447	49.500000	.00000000E+00
16.00000000	10322.660	33.000000	2459.4090	50.000000	.00000000E+00
16.50000000	9946.3035	33.500000	2363.0329	.00000000E+00	.00000000E+00

FUEL SURFACE AREA---SLOT REGION NUMBER ONE----SQUARE INCHES			
.00000000E+00	14062.054	17.000000	16266.212
.50000000	14099.219	17.500000	16034.568
1.00000000	14297.136	18.000000	15805.726
1.50000000	14493.521	18.500000	15578.287
2.00000000	14688.375	19.000000	15351.198
2.50000000	14881.698	19.500000	15123.645
3.00000000	15073.489	20.000000	14894.984
3.50000000	15263.749	20.500000	14664.706
4.00000000	15452.478	21.000000	14432.395
4.50000000	15639.675	21.500000	14197.710
5.00000000	15825.341	22.000000	13960.370
5.50000000	16009.476	22.500000	13720.138
6.00000000	16192.079	23.000000	13476.816
6.50000000	16373.151	23.500000	13230.235
7.00000000	16552.692	24.000000	12980.250
7.50000000	16730.702	24.500000	12669.045
8.00000000	16907.180	25.000000	12457.642
8.50000000	17082.127	25.500000	12208.126
9.00000000	17255.542	26.000000	11954.106
9.50000000	17427.426	26.500000	11698.117
10.000000	17597.779	27.000000	11440.596
10.500000	17766.600	27.500000	11181.595
11.000000	17933.890	28.000000	10921.061
11.500000	18099.649	28.500000	10600.343
12.000000	18263.877	29.000000	10275.656
12.500000	18426.573	29.500000	9950.1870
13.000000	18587.738	30.000000	9623.7398
13.500000	18748.902	30.500000	9296.1352
14.000000	18909.897	31.000000	8967.2121
14.500000	19069.326	31.500000	8636.8255
15.000000	19227.871	32.000000	8304.8442
15.500000	19385.342	32.500000	7971.1497
16.000000	19541.289	33.000000	7635.6343
16.500000	19695.560	33.500000	7298.2005
		34.000000	6958.7594
		34.500000	6617.2297
		35.000000	6273.5375
		35.500000	5927.6148
		36.000000	5579.3993
		36.500000	5228.8340
		37.000000	4875.8660
		37.500000	4520.4470
		38.000000	4162.5320
		38.500000	3802.0797
		39.000000	3439.0517
		39.500000	3073.4100
		40.000000	2705.1254
		40.500000	2334.1673
		41.000000	1960.5072
		41.500000	1584.1189
		42.000000	1204.9781
		42.500000	823.06362
		43.000000	438.36203
		43.500000	51.083702
		44.000000	.00000000E+00
		44.500000	.00000000E+00
		45.000000	.00000000E+00
		45.500000	.00000000E+00
		46.000000	.00000000E+00
		46.500000	.00000000E+00
		47.000000	.00000000E+00
		47.500000	.00000000E+00
		48.000000	.00000000E+00
		48.500000	.00000000E+00
		49.000000	.00000000E+00
		49.500000	.00000000E+00
		50.000000	.00000000E+00
		.00000000E+00	.00000000E+00

FUEL SURFACE AREA--1ST SEGMENT CP REGION--SQUARE INCHES

.00000000E+00	51430.494	17.000000	78237.528	34.000000	102704.70
.50000000	52252.337	17.500000	78990.546	34.500000	103388.90
1.00000000	53072.156	18.000000	79741.541	35.000000	104071.08
1.50000000	53889.951	18.500000	80490.512	35.500000	104751.24
2.00000000	54705.721	19.000000	81237.459	36.000000	105429.37
2.50000000	55519.466	19.500000	81982.382	36.500000	106105.48
3.00000000	56331.187	20.000000	82725.280	37.000000	106779.57
3.50000000	57140.884	20.500000	83466.155	37.500000	107451.63
4.00000000	57948.556	21.000000	84205.005	38.000000	108121.67
4.50000000	58754.204	21.500000	84941.832	38.500000	108789.68
5.00000000	59557.828	22.000000	85676.634	39.000000	109455.67
5.50000000	60359.427	22.500000	86409.412	39.500000	110119.63
6.00000000	61159.002	23.000000	87140.167	40.000000	110781.56
6.50000000	61956.553	23.500000	87868.897	40.500000	111441.46
7.00000000	62752.080	24.000000	88595.603	41.000000	112099.34
7.50000000	63545.582	24.500000	89320.286	41.500000	112755.20
8.00000000	64337.060	25.000000	90042.944	42.000000	113409.04
8.50000000	65126.513	25.500000	90763.578	42.500000	114060.85
9.00000000	65913.943	26.000000	91482.189	43.000000	114710.64
9.50000000	66699.348	26.500000	92198.775	43.500000	115358.41
10.000000	67482.729	27.000000	92913.337	44.000000	116048.80
10.500000	68264.086	27.500000	93625.876	44.500000	116710.64
11.000000	69043.419	28.000000	94336.390	45.000000	117358.185
11.500000	69820.727	28.500000	95044.881	45.500000	118035.947
12.000000	70596.012	29.000000	95751.347	46.000000	118710.64
12.500000	71369.272	29.500000	96455.790	46.500000	119388.41
13.000000	72140.508	30.000000	97158.209	47.000000	120060.85
13.500000	72909.720	30.500000	97858.604	47.500000	120735.185
14.000000	73676.908	31.000000	98556.975	48.000000	121409.04
14.500000	74442.071	31.500000	99253.322	48.500000	122081.56
15.000000	75205.211	32.000000	99947.645	49.000000	122755.20
15.500000	75966.326	32.500000	100639.94	49.500000	123429.37
16.000000	76725.417	33.000000	101330.22	50.000000	124105.48
16.500000	77482.484	33.500000	102018.47	.00000000E+00	124781.56

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FUEL SURFACE AREA--2ND SEGMENT CP REGION--SQUARE INCHES

.0000000E+00	81747.473	17.000000	128690.29	34.000000	175633.10
.50000000	83128.144	17.500000	130070.96	34.500000	177013.78
1.00000000	84508.815	18.000000	131451.63	35.000000	178394.45
1.50000000	85889.486	18.500000	132832.30	35.500000	179775.12
2.00000000	87270.157	19.000000	134212.97	36.000000	181155.79
2.50000000	88650.828	19.500000	135593.64	36.500000	182536.46
3.00000000	90031.499	20.000000	136974.31	37.000000	183917.13
3.50000000	91412.170	20.500000	138354.99	37.500000	185297.80
4.00000000	92792.841	21.000000	139735.66	38.000000	186678.47
4.50000000	94173.512	21.500000	141116.33	38.500000	188059.14
5.00000000	95554.183	22.000000	142497.00	39.000000	189439.81
5.50000000	96934.854	22.500000	143877.67	39.500000	190820.49
6.00000000	98315.525	23.000000	145258.34	40.000000	192201.16
6.50000000	99696.196	23.500000	146639.01	40.500000	193581.83
7.00000000	101076.87	24.000000	148019.68	41.000000	194962.50
7.50000000	102457.54	24.500000	149400.35	41.500000	196343.17
8.00000000	103838.21	25.000000	150781.03	42.000000	197723.84
8.50000000	105218.88	25.500000	152161.70	42.500000	198767.66
9.00000000	106599.55	26.000000	153542.37	43.000000	198868.81
9.50000000	107980.22	26.500000	154923.04	43.500000	182289.18
10.00000000	109360.89	27.000000	156303.71	44.000000	149978.52
10.50000000	110741.56	27.500000	157684.38	44.500000	116158.91
11.00000000	112122.24	28.000000	159065.05	45.000000	81169.272
11.50000000	113502.91	28.500000	160445.72	45.500000	45817.656
12.00000000	114883.58	29.000000	161826.39	46.000000	.00000000E+00
12.50000000	116264.25	29.500000	163207.06	46.500000	.00000000E+00
13.00000000	117644.92	30.000000	164587.74	47.000000	.00000000E+00
13.50000000	119025.59	30.500000	165968.41	47.500000	.00000000E+00
14.00000000	120406.26	31.000000	167349.08	48.000000	.00000000E+00
14.50000000	121786.93	31.500000	168729.75	48.500000	.00000000E+00
15.00000000	123167.60	32.000000	170110.42	49.000000	.00000000E+00
15.50000000	124548.28	32.500000	171491.09	49.500000	.00000000E+00
16.00000000	125928.95	33.000000	172871.76	50.000000	.00000000E+00
16.50000000	127309.62	33.500000	174252.43	.00000000E+00	.00000000E+00

FUEL SURFACE AREA--SLOT REGION NUMBER TWO--SQUARE INCHES

.00000000E+00	13957.780	17.000000	15996.114	34.000000	6512.9831
.50000000	13989.051	17.500000	15760.607	34.500000	6167.4617
1.00000000	14181.065	18.000000	15527.805	35.000000	5819.7715
1.50000000	14371.538	18.500000	15296.332	35.500000	5469.8449
2.00000000	14560.472	19.000000	15065.148	36.000000	5117.6201
2.50000000	14747.867	19.500000	14833.452	36.500000	4763.0400
3.00000000	14933.721	20.000000	14600.610	37.000000	4406.0524
3.50000000	15118.036	20.500000	14366.117	37.500000	4046.6090
4.00000000	15300.811	21.000000	14129.563	38.000000	3684.6654
4.50000000	15482.046	21.500000	13890.612	38.500000	3320.1805
5.00000000	15661.741	22.000000	13648.984	39.000000	2953.1160
5.50000000	15839.896	22.500000	13404.446	39.500000	2583.4369
6.00000000	16016.512	23.000000	13156.802	40.000000	2211.1103
6.50000000	16191.588	23.500000	12905.885	40.500000	1836.1059
7.00000000	16365.124	24.000000	12627.045	41.000000	1458.3953
7.50000000	16537.120	24.500000	12389.302	41.500000	1077.9523
8.00000000	16707.577	25.000000	12136.724	42.000000	694.75243
8.50000000	16876.494	25.500000	11881.889	42.500000	308.77400
9.00000000	17043.871	26.000000	11625.748	43.000000	.00000000E+00
9.50000000	17209.708	26.500000	11368.396	43.500000	.00000000E+00
10.000000	17374.005	27.000000	11109.761	44.000000	.00000000E+00
10.500000	17536.763	27.500000	10849.732	44.500000	.00000000E+00
11.000000	17697.981	28.000000	10526.202	45.000000	.00000000E+00
11.500000	17857.659	28.500000	10198.104	45.500000	.00000000E+00
12.000000	18015.797	29.000000	9869.4648	46.000000	.00000000E+00
12.500000	18172.395	29.500000	9540.0530	46.500000	.00000000E+00
13.000000	18327.454	30.000000	9209.6647	47.000000	.00000000E+00
13.500000	18111.744	30.500000	8878.1172	47.500000	.00000000E+00
14.000000	17669.057	31.000000	8545.2474	48.000000	.00000000E+00
14.500000	17319.803	31.500000	8210.9086	48.500000	.00000000E+00
15.000000	17017.204	32.000000	7874.9689	49.000000	.00000000E+00
15.500000	16741.807	32.500000	7537.3093	49.500000	.00000000E+00
16.000000	16483.471	33.000000	7197.8221	50.000000	.00000000E+00
16.500000	16236.193	33.500000	6856.4096	.00000000E+00	.00000000E+00

COLUMN #6 ON THE PLOT FILE V16+V17

.00000000E+00	95705.253	17.000000	144686.40	34.000000	182146.09
.50000000	97117.194	17.500000	145831.57	34.500000	183181.24
1.00000000	98689.879	18.000000	146979.44	35.000000	184214.22
1.50000000	100261.02	18.500000	148128.63	35.500000	185244.96
2.00000000	101830.63	19.000000	149278.12	36.000000	186273.41
2.50000000	103398.69	19.500000	150427.10	36.500000	187299.50
3.00000000	104965.22	20.000000	151574.92	37.000000	188323.18
3.50000000	106530.21	20.500000	152721.10	37.500000	189344.41
4.00000000	108093.65	21.000000	153865.22	38.000000	190363.14
4.50000000	109655.56	21.500000	155006.94	38.500000	191379.32
5.00000000	111215.92	22.000000	156145.98	39.000000	192392.93
5.50000000	112774.75	22.500000	157282.12	39.500000	193403.92
6.00000000	114332.04	23.000000	158415.14	40.000000	194412.27
6.50000000	115887.78	23.500000	159544.90	40.500000	195417.93
7.00000000	117441.99	24.000000	160646.73	41.000000	196420.89
7.50000000	118994.66	24.500000	161789.66	41.500000	197421.12
8.00000000	120545.79	25.000000	162917.75	42.000000	198418.59
8.50000000	122095.37	25.500000	164043.59	42.500000	199076.44
9.00000000	123643.42	26.000000	165168.12	43.000000	198868.81
9.50000000	125189.93	26.500000	166291.43	43.500000	182289.18
10.000000	126734.90	27.000000	167413.47	44.000000	149978.52
10.500000	128278.33	27.500000	168534.11	44.500000	116158.91
11.000000	129820.22	28.000000	169591.25	45.000000	81169.272
11.500000	131360.57	28.500000	170643.83	45.500000	45817.656
12.000000	132899.37	29.000000	171695.86	46.000000	.00000000E+00
12.500000	134436.64	29.500000	172747.12	46.500000	.00000000E+00
13.000000	135972.37	30.000000	173797.40	47.000000	.00000000E+00
13.500000	137137.34	30.500000	174846.52	47.500000	.00000000E+00
14.000000	138075.32	31.000000	175894.33	48.000000	.00000000E+00
14.500000	139106.74	31.500000	176940.66	48.500000	.00000000E+00
15.000000	140184.81	32.000000	177985.39	49.000000	.00000000E+00
15.500000	141290.08	32.500000	179028.40	49.500000	.00000000E+00
16.000000	142412.42	33.000000	180069.58	50.000000	.00000000E+00
16.500000	143545.81	33.500000	181108.84	.00000000E+00	.00000000E+00

FUEL SURFACE AREA--3RD SEGMENT CP REGION--SQUARE INCHES

.00000000E+00	72126.061	17.000000	106921.31	34.000000	110150.45
.50000000	73148.188	17.500000	107946.09	34.500000	106901.50
1.00000000	74170.380	18.000000	108970.95	35.000000	103622.97
1.50000000	75192.639	18.500000	109995.88	35.500000	100314.84
2.00000000	76214.967	19.000000	111020.87	36.000000	96977.119
2.50000000	77237.366	19.500000	112045.94	36.500000	93609.808
3.00000000	78259.837	20.000000	113071.07	37.000000	90212.906
3.50000000	79282.380	20.500000	114096.27	37.500000	86786.413
4.00000000	80304.999	21.000000	115121.53	38.000000	83330.328
4.50000000	81327.692	21.500000	116146.85	38.500000	79847.249
5.00000000	82350.463	22.000000	117172.23	39.000000	76335.953
5.50000000	83373.312	22.500000	118197.68	39.500000	72696.775
6.00000000	84396.239	23.000000	119223.17	40.000000	68735.857
6.50000000	85419.246	23.500000	120248.73	40.500000	64739.839
7.00000000	86442.334	24.000000	121274.33	41.000000	60708.721
7.50000000	87465.503	24.500000	122299.99	41.500000	56642.502
8.00000000	88488.753	25.000000	123325.70	42.000000	52541.184
8.50000000	89512.086	25.500000	124351.45	42.500000	48404.765
9.00000000	90535.502	26.000000	125377.25	43.000000	44233.246
9.50000000	91559.000	26.500000	126403.09	43.500000	.00000000E+00
10.00000000	92582.582	27.000000	127428.97	44.000000	.00000000E+00
10.50000000	93606.246	27.500000	128454.90	44.500000	.00000000E+00
11.00000000	94629.994	28.000000	129480.86	45.000000	.00000000E+00
11.50000000	95653.825	28.500000	130506.85	45.500000	.00000000E+00
12.00000000	96677.739	29.000000	131532.88	46.000000	.00000000E+00
12.50000000	97701.735	29.500000	132558.95	46.500000	.00000000E+00
13.00000000	98725.813	30.000000	133254.68	47.000000	.00000000E+00
13.50000000	99749.973	30.500000	133881.89	47.500000	.00000000E+00
14.00000000	100774.21	31.000000	134506.34	48.000000	.00000000E+00
14.50000000	101798.53	31.500000	130743.17	48.500000	.00000000E+00
15.00000000	102822.94	32.000000	126641.84	49.000000	.00000000E+00
15.50000000	103847.41	32.500000	122362.66	49.500000	.00000000E+00
16.00000000	104871.97	33.000000	117870.18	50.000000	.00000000E+00
16.50000000	105896.60	33.500000	113369.97	.00000000E+00	.00000000E+00

COLUMN #7 ON THE PLOT FILE V18+V19				
.00000000E+00	72126.061	17.000000	106921.31	110150.45
.50000000	73148.188	17.500000	107946.09	106901.50
1.00000000	74170.380	18.000000	108970.95	103622.97
1.50000000	75192.639	18.500000	109995.88	100314.84
2.00000000	76214.967	19.000000	111020.87	96977.119
2.50000000	77237.366	19.500000	112045.94	93609.808
3.00000000	78259.837	20.000000	113071.07	90212.906
3.50000000	79282.380	20.500000	114096.27	86786.413
4.00000000	80304.999	21.000000	115121.53	83330.328
4.50000000	81327.692	21.500000	116146.85	79847.249
5.00000000	82350.463	22.000000	117172.23	76335.953
5.50000000	83373.312	22.500000	118197.68	72696.775
6.00000000	84396.239	23.000000	119223.17	68735.857
6.50000000	85419.246	23.500000	120248.73	64739.839
7.00000000	86442.334	24.000000	121274.33	60708.721
7.50000000	87465.503	24.500000	122299.99	56642.502
8.00000000	88488.753	25.000000	123325.70	52541.184
8.50000000	89512.086	25.500000	124351.45	48404.765
9.00000000	90535.502	26.000000	125377.25	44233.246
9.50000000	91559.000	26.500000	126403.09	.00000000E+00
10.000000	92582.582	27.000000	127428.97	.00000000E+00
10.500000	93606.246	27.500000	128454.90	.00000000E+00
11.000000	94629.994	28.000000	129480.86	.00000000E+00
11.500000	95653.825	28.500000	130506.85	.00000000E+00
12.000000	96677.739	29.000000	131532.88	.00000000E+00
12.500000	97701.735	29.500000	132558.95	.00000000E+00
13.000000	98725.813	30.000000	133254.68	.00000000E+00
13.500000	99749.973	30.500000	133881.89	.00000000E+00
14.000000	100774.21	31.000000	134506.34	.00000000E+00
14.500000	101798.53	31.500000	130743.17	.00000000E+00
15.000000	102822.94	32.000000	126641.84	.00000000E+00
15.500000	103847.41	32.500000	122362.66	.00000000E+00
16.000000	104871.97	33.000000	117870.18	.00000000E+00
16.500000	105896.60	33.500000	113369.97	.00000000E+00

	AFT END	BURN AREA	TOTAL	SQUARE INCHES	
.00000000E+00	13993.154	17.000000	8350.8078	34.000000	.00000000E+00
.50000000	14116.825	17.500000	7589.9191	34.500000	.00000000E+00
1.00000000	14243.690	18.000000	6817.8384	35.000000	.00000000E+00
1.50000000	14262.052	18.500000	6034.5611	35.500000	.00000000E+00
2.00000000	14269.401	19.000000	5256.5363	36.000000	.00000000E+00
2.50000000	14276.725	19.500000	4583.1391	36.500000	.00000000E+00
3.00000000	14285.462	20.000000	3900.2303	37.000000	.00000000E+00
3.50000000	14292.754	20.500000	3599.1596	37.500000	.00000000E+00
4.00000000	14215.856	21.000000	3322.3480	38.000000	.00000000E+00
4.50000000	14125.370	21.500000	4333.2754	38.500000	.00000000E+00
5.00000000	14031.805	22.000000	4077.5306	39.000000	.00000000E+00
5.50000000	13935.134	22.500000	3827.1547	39.500000	.00000000E+00
6.00000000	13835.333	23.000000	3581.5866	40.000000	.00000000E+00
6.50000000	13734.186	23.500000	3333.7506	40.500000	.00000000E+00
7.00000000	13635.452	24.000000	3083.6468	41.000000	.00000000E+00
7.500000	13533.637	24.500000	2831.2753	41.500000	.00000000E+00
8.00000000	13428.720	25.000000	2576.6359	42.000000	.00000000E+00
8.50000000	13320.685	25.500000	2319.7286	42.500000	.00000000E+00
9.00000000	13209.513	26.000000	2060.5536	43.000000	.00000000E+00
9.50000000	13095.190	26.500000	1799.1107	43.500000	.00000000E+00
10.000000	12977.700	27.000000	1535.4000	44.000000	.00000000E+00
10.500000	12819.423	27.500000	1271.8657	44.500000	.00000000E+00
11.000000	12654.992	28.000000	986.01372	45.000000	.00000000E+00
11.500000	12477.887	28.500000	691.31678	45.500000	.00000000E+00
12.000000	12278.061	29.000000	393.63757	46.000000	.00000000E+00
12.500000	12074.025	29.500000	56.383926	46.500000	.00000000E+00
13.000000	11865.769	30.000000	.00000000E+00	47.000000	.00000000E+00
13.500000	11625.025	30.500000	.00000000E+00	47.500000	.00000000E+00
14.000000	11333.930	31.000000	.00000000E+00	48.000000	.00000000E+00
14.500000	11037.579	31.500000	.00000000E+00	48.500000	.00000000E+00
15.000000	10676.280	32.000000	.00000000E+00	49.000000	.00000000E+00
15.500000	10215.364	32.500000	.00000000E+00	49.500000	.00000000E+00
16.000000	9668.8664	33.000000	.00000000E+00	50.000000	.00000000E+00
16.500000	9025.2010	33.500000	.00000000E+00	.00000000E+00	.00000000E+00

COLUMN #8 ON THE PLOT FILE V20+V21+V30			
.00000000E+00	13993.154	17.000000	8350.8078
.50000000	14116.825	17.500000	7589.9191
1.00000000	14243.690	18.000000	6817.8384
1.50000000	14262.052	18.500000	6034.5611
2.00000000	14269.401	19.000000	5256.5363
2.50000000	14276.725	19.500000	4583.1391
3.00000000	14285.462	20.000000	3900.2303
3.50000000	14292.754	20.500000	3599.1596
4.00000000	14215.856	21.000000	3322.3480
4.50000000	14125.370	21.500000	4333.2754
5.00000000	14031.805	22.000000	4077.5306
5.50000000	13935.134	22.500000	3827.1547
6.00000000	13835.333	23.000000	3581.5866
6.50000000	13734.186	23.500000	3333.7506
7.00000000	13635.452	24.000000	3083.6468
7.50000000	13533.637	24.500000	2831.2753
8.00000000	13428.720	25.000000	2576.6359
8.50000000	13320.685	25.500000	2319.7286
9.00000000	13209.513	26.000000	2060.5536
9.50000000	13095.190	26.500000	1799.1107
10.000000	12977.700	27.000000	1535.4000
10.500000	12819.423	27.500000	1271.8657
11.000000	12654.992	28.000000	986.01372
11.500000	12477.887	28.500000	691.31678
12.000000	12278.061	29.000000	393.63757
12.500000	12074.025	29.500000	56.383926
13.000000	11865.769	30.000000	.00000000E+00
13.500000	11625.025	30.500000	.00000000E+00
14.000000	11333.930	31.000000	.00000000E+00
14.500000	11037.579	31.500000	.00000000E+00
15.000000	10676.280	32.000000	.00000000E+00
15.500000	10215.364	32.500000	.00000000E+00
16.000000	9668.8664	33.000000	.00000000E+00
16.500000	9025.2010	33.500000	.00000000E+00

*** END PROGRAM CERM ***

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15. Supplementary Notes			
16. Abstract A previous report (no. 5-32279, contract NAS8-36955, DO 51), describes the measures taken to adapt the NASA Complex Burning Region Model and code so that it was applicable to the Advanced Solid Rocket Motor as envisioned at that time. The code so modified was called the CBRM-A. CBRM-A could calculate the port volume and burning area for the star, transition, and cylindrically perforated regions of the motor. This report describes a subsequent effort to add computation of port volume and burning area for the Advanced Solid Rocket Motor head dome. Sample input, output and an overview of the models used are included in this report. The software was configured in two forms; a stand-alone head dome code and a code integrating the head dome solution with the CBRM-A.			
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